SOUTHERN GEORGIA AND ITS HYDROGRAPHY.¹

ALONG the eastern coast of North America, commencing at Long Island and passing southward through Virginia, North and South Carolina, Georgia, and Florida, there lies a broad tract of country known as the Atlantic Coastal Plain. This plain, which also extends round the northern part of the Gulf of Mexico, where it is distinguished as the Gulf Coastal Plain, is a region of low elevation, with a relatively gentle seaward slope. Part of it passes through and embraces 35,000 square miles of the southern half of the State of Georgia, and this constitutes the purview of an extremely interesting and informative report issued by the United States Geological Survey, from which the following particulars are gleaned.

Although characterised as a plain in comparison with the mountainous country behind, the expanse under consideration is not entirely without topographical features and contrasts. There are hilly and broken areas, especially towards the north, but these do not rise above the general level, and their summits present an even skyline. The plain lends itself to subdivision into six physiographical districts, the nature of which may be to a large extent gauged from their designations, viz., the Fall-Line Hills, the Dougherty Plain, the Altamaha Upland, the Southern Lime-Sink Region, the Okefenokee Plain, and the Satilla Coastal Lowland. The lithological components of these belts are principally sands, clays, and marls, with, subordinately, limestones and sandstones. The former are largely unconsolidated, and have undergone little alteration since their original deposition. The sediments are representative of the Lower Cretaceous and subsequent systems, and include the Ripley Formation, about 950 ft. thick, of grey, calcareous, and micaceous sand, and sandy clay, and the Midway Formation, about 400 ft. thick, of ferruginous sand, with local beds of white clay, and fossiliferous limestone and calcareous quartzite. The Cretaceous deposits immediately and unconformably overlies a basement of crystalline rocks believed to be pre-Cambrian.

The mean annual rainfall of the plain is about 49 in., and the quantity absorbed by the soil and rocks is roughly estimated at 90 to 95 per cent. of the total. If nearly 60 per cent. of the rainfall be assumed to be lost by evaporation and 4 or 5 per cent. escape as run-off or flood-flow, there remains about 35 per cent. to form the underground water supply; but much of this is not actually utilisable, on account of the depth to which it descends.

Although several of the cities in central Georgia, such as Augusta and Macon, obtain their water supplies from adjacent rivers, the majority of the inhabitants have to depend upon supplies drawn from artesian wells, of which there are probably some 700 or 800 in active operation. These wells range in depth from 100 to 1000 ft. All the Cretaceous formations contain water-bearing strata, as also the Eocene and Oligocene series of the Tertiary system. The Quaternary system furnishes non-artesian water, which is tapped by shallow borings. Such water, on account of its high content of organic matter in many cases, is not generally suitable for domestic use.

A large number of analyses of the ground waters have been made, and from them it is computed that relatively few contain normal carbonate (CO₂), while the presence of hydrogen-sulphide gas and of excessive amounts of iron is reported in waters from all the formations. The gas imparts an objectionable odour

in certain instances and gives rise to corrosion in boilers and mains. The iron, which in a number of cases exceeds three parts per million, is then perceptible to the taste, and tends to produce stains in fabrics which are washed in it. B. C.

HARDNESS AND CRITICAL COOLING VELOCITIES OF STEELS.

THE maximum cutting hardness of pure carbon tool steel is achieved by water-quenching. With the introduction of Mushet's special steel, engineers obtained a material which was called "self-hardening," because it did not require to be water-quenched in order to bring out its maximum cutting hardness. It was sufficient for the tool to be cooled from above a certain critical temperature in air. The modern high-speed tool steel falls into the same class of materials, the chief difference from Mushet's special steel being that the "lip" or "nose" of the tool requires to be actually melted and then cooled in an air blast if the maximum cutting hardness is to be obtained. Stated in general terms, therefore, the rapid-cutting tool of to-day is gas-quenched as contrasted with the carbon tool, which is water-quenched.

Various theories of the mechanism of the above changes are held, and therefore the research by Prof. C. A. Edwards, of the University of Manchester, assisted by J. N. Greenwood and H. Kikkawa, recently presented to the Iron and Steel Institute, on some very remarkable properties of a chromium steel, is to be welcomed in that it throws valuable light on what are to some extent matters of dispute. This steel contained 6.15 per cent. of chromium and 0.63 per cent. of carbon, the balance being iron, except for impurities unavoidably present in small amounts. By suitably varying the initial temperature and the cooling velocity of this steel by air-quenching, Brinell hardness numbers varying from 194 to 700 could be obtained. Such a material therefore falls within the category of self-hardening steels in the sense that water-quenching is not required to harden it. On the other hand, it was found that unless a certain critical velocity of cooling was exceeded depending on the initial temperature this steel did not harden. In this sense, therefore, the steel does not appear to be self-hardening. On this point the authors say:—"Whilst with the chromium steel the cooling rates which produce hardening are extremely slow as compared with those which are obtained in the hardening of steels by quenching, the two operations are fundamentally the same. In other words, a given rate of cooling, which might be regarded as slow for carbon steels, really constitutes quenching in the case of some special alloy steels." The authors have further found that the hardening of the steel coincides with the presence of large quantities of martensite, and a diminution in the magnitude of the carbide thermal change. The maximum hardness was obtained when the thermal transformation had been entirely prevented, and when this was accomplished the steel was purely martensitic in structure. The following table gives the connection between the initial temperature and the cooling velocities between 836° C. and 546° C. which suppress the carbide change:—

Initial temperature °C	Cooling velocities			
860	...	...	...	1 36
908	...	...	...	2 24
960	...	...	...	3 0
1029	...	...	...	4 0
1147	...	...	...	6 0
1200	...	...	...	7 0
1267	...	...	...	8 56

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¹ "Underground Waters of the Coastal Plain of Georgia." By L. W. Stephenson, J. O. Veatch, and R. B. Dole. (Water Supply Paper No. 341.) Pp. 530, with photographs, maps, and diagrams. Washington: United States Geological Survey, 1915.